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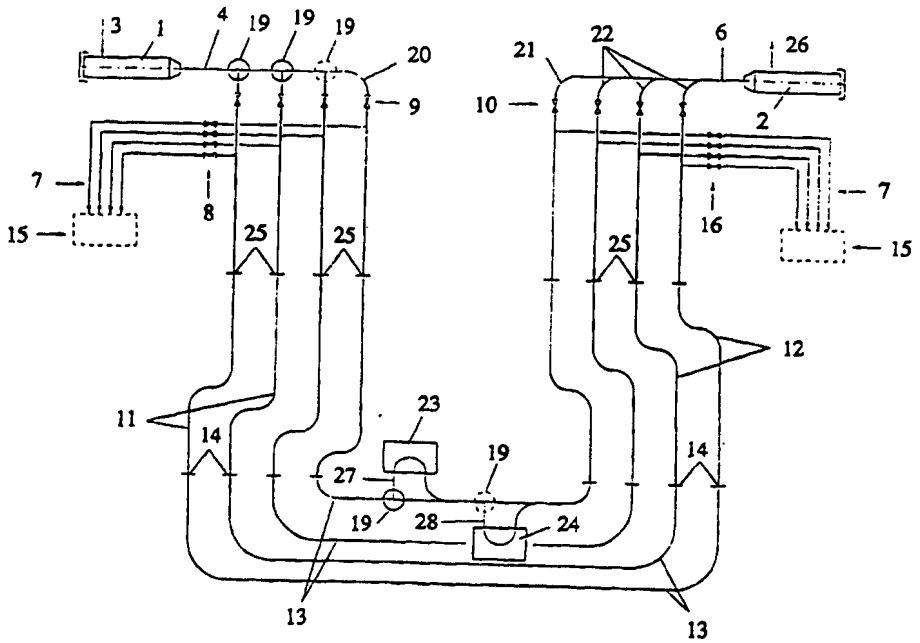

(57) Abstract

A pig system for sending and receiving pigs in a pipe system, for example between a production ship or platform and a well head on the sea floor, comprises a pig sender and pig receiver arranged in connection with the pipe system. The pig sender (1) is connected with one or more pig switches (19) arranged in series which are provided with two or more switch-over passages (46, 47, 46[1], 47[1]) and are designed to steer a pig to a subsequent pig switch or one of several alternative pipes or pipe loops (20).

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Pig system for sending and receiving pigs in a pipeline system

The present invention concerns a pig system for sending and receiving pigs in a pipe system and a device for switching a pig into a selected pipe or pipe loop, comprising a sender and receiver for the pigs arranged in connection with the pipe system.

In connection with the extraction of oil and gas, for example at sea, the oil and gas are conducted from an underground reservoir or well via a well head on the sea floor and on through a rising pipe to a pipe system with connected processing equipment on a platform, ship etc. on the surface of the sea.

A so-called pig is used to inspect or scrape/clean the inside of the pipes; the pig is cylindrical in shape and provided with a video camera, brush etc. to carry out the required work. The pig is placed in a pig sender and is propelled into the desired pipe or pipe loop by means of a propellant. A pig receiver arranged in connection with the end of the pipe or the pipe loop is designed to receive the pig when the work has been completed.

On a ship or platform for the production of oil or gas there are usually several well flow pipes or pipe loops which must be pigged. In standard practice a sender and a receiver are used for each of the pipes/pipe loops. Or, on a ship with a rotating tower where space is more limited, a mobile pig sender (and, possibly, receiver) is used and is mounted on a temporary basis in connection with the pipe or pipe loop which is to be pigged.

A sender or receiver has a typical length of 3-4 metres. In addition, a further 3-4 metres of space is required in the longitudinal and lateral directions to enable the pig to be handled in connection with insertion into the sender and removal from the receiver. In systems where there are many pipes and pipe loops which are to be pigged and where a permanently connected sender/receiver system is used, the total space requirements are, therefore, very great and the total weight is correspondingly high.

In a system with a mobile sender and receiver which are connected to and disconnected from the various pipes and pipe loops, a relatively high level of manual effort is required to move, connect and pressure-test the connections. Moreover, this last solution represents a high risk since the work which must be carried out in the connection operation takes place when the pipe system is under pressure.

On a production ship with a rotating tower the pig sender/receiver system can either be arranged on the rotating tower or a connection with a flexible hose between the rotating tower and the ship may be used to connect the pig sender/receiver to the pipe loop or pipe which is to be pigged. In the first instance there is limited space, while in the second instance the connection work is more extensive and the risk of accident is high.

With the present invention, a pig system for sending pigs in a pipe system has been designed which is considerably simpler and requires considerably less space than the existing solutions. Moreover, the pig system in accordance with the present invention is considerably simpler to operate and, therefore, requires less manual labour.

The present invention is particularly well suited for use on production ships with rotating towers where space is limited, but it may also be used to advantage on fixed or floating platforms.

The present invention is characterised in that the pig sender is connected with one or more pig switches arranged in series which are provided with two or more switch-over passages and are designed to steer a pig to a subsequent pig switch or, possibly, at least two alternative pipes or pipe loops as defined in the enclosed claim 1.

An independent claim 2 concerning a switch in accordance with the present invention is characterised in that it comprises a switch housing with an internal, change-over switch piston with two or more pipes, that the housing is provided with an inlet and two or more outlets, and that the piston can be switched over by means of a spindle so that one of the pipes corresponds with the inlet and one of the outlets, depending on the position of the piston.

Further advantageous features of the present invention are defined in the dependent claims 3 and 4.

The present invention will be described in the following by means of examples and with reference to the enclosed drawings in which:

Fig. 1 shows diagrammatically a production pipe system with a pig system in accordance with the present invention.

Fig. 2 shows a diagram of a pig switch which is used in the system shown in Fig. 1.

Fig. 3 shows the same pig switch as in Fig. 2., but where an internal switch piston has been moved to an upper position.

Fig. 4 shows an enlargement of details of the pig switch shown in Fig. 3.

Fig. 5 shows an alternative design of pig switch with a rotatable switch piston and

Fig. 6 shows the same switch as in Fig. 5, but with the piston

rotated through 90°.

The production pipe system shown in Fig. 1 comprises risers 11, 12 which are connected to a pipe connection 25 on a production platform or ship (not shown in detail), and collecting pipes 13 which connect the well manifolds 23, 24 with the riser connection 14 on the sea floor via the pipe loops 27, 28. Only two well manifold connections 23, 24 are shown on the drawing, but each of the collecting pipes 13 is connected with such connections, even though this is not shown in detail.

The pig system comprises a pig sender 1, which is connected via a pipe 4 to pig switches 19, and a pig receiver 2 which is connected with a Y branch 22 via a pipe 6. The pig switches 19 and the Y branches 22 are, in turn, connected to risers via pipe connections 20, 21 on the platform. In addition to the pig switches 18 on the platform, in connection with the well manifold, further pig switches 19 are arranged on the sea floor to make it possible to conduct the pigs via the pipe loops 27, 28 through the well manifold or straight through the collecting pipes 13.

From what is described above and shown in Fig. 1 it will be clear that the present example comprises a production pipe system with a total of eight risers, where both the pig sender and the pig receiver are mounted on the platform or ship in such a way that the pigs can be sent down through a riser 11 from the pig sender and up through another riser 12 to the pig receiver.

During the production of oil or gas, oil flows from the well manifold through the collecting pipes 13 and on via the risers 11, 12 and the pipe system 7 to the processing equipment 15. The valves 9, 10 for the switching system are closed in this connection.

With the present invention it is possible to inspect or clean just one pipe in the production pipe system at a time while the other pipes are in operation. This can be done in the following

way: a pig is inserted into the pig sender 1 and closed (not shown in detail). Then a propellant is added for the pig through a supply system 3 (not shown in detail) with a certain excess pressure. Depending on the production pipes which need to be inspected or cleaned, one of the valves 9 or 10 is opened at the same time as the corresponding valves 8, 16 in the pipe system 7 are shut. Moreover, the switches 19 are set to the correct position for the production pipe selected. Using a propellant in the form of a stabilised oil or the like, the pig may now be conducted through the selected production pipe from the pig sender 1 to the pig receiver 2. Oil or gas which is ahead of the pig during the pigging operation is drained to a drainage system 26 (not shown in detail) which is connected to the pig receiver 2. As stated above, further pig switches 19 can be arranged on the sea floor to make it possible, if required, to conduct the pigs via the pipe loops 27, 28 through the well manifold.

After the pig has arrived at the pig receiver 2, the valves 9, 10 are closed and the supply of propellant to the pig sender (via system 3) is stopped at the same time. Transportation of oil and gas through the production pipe which has just been pigged can then be resumed by opening valves 8, 9 for the production pipe concerned and a new production pipe can be pigged by following the same procedure as stated above.

The pig switch 19 in accordance with the present invention is shown in detail in fig. 2. It consists of a switch housing 31 with a cover 34 and an internal, axially (vertically) movable switch piston 36. The switch piston is provided with an upper, diametrically arranged pipe 46 and a lower, slightly bent pipe 47. The upper pipe 46 corresponds with the pipe sockets 50, 51 arranged diametrically in the housing 31 when the switch piston is in its lower position and the lower pipe 47 corresponds with the pipe socket 50 and a third pipe socket 52 in the housing 31 when the piston is in its upper position as shown in fig. 3. The pipes and the pipe sockets have an internal diameter which corresponds with the diameter of the production pipe system shown in fig. 1 and are provided with flanges 43, 44, 45 for connection

to the pipe system concerned.

The switch piston 36 can be raised and lowered via a piston rod or spindle 35 which stretches down through the cover 34 into a control and sealing box 53 (not shown in detail). The opening 55 in the piston ensures that the liquid (oil or gas) which is on one side of the piston, at the one end of the switch housing, can flow over to the other side when the piston is moved from the upper position to the lower position or vice-versa. Moreover, the piston is prevented from rotating by means of tracking controls 41, 42 arranged diametrically above one another in the piston/housing 36, 31.

Details C and D in fig. 4 show in larger scale the transition between the pipes 46, 47 in the switch piston and the pipe sockets 50, 51 and 52. In the transition between the pipe socket 50 and the pipe 46 (detail C) at the inlet to the switch, the pipe is inclined as indicated with the angle α. Correspondingly the inlet part of pipe sockets 51, 52 are inclined at the outlet of the switch (detail D), also indicated with an angle α. This is done to prevent the pig becoming stuck when it passes through the switch.

Detail E in fig. 4 shows a gasket 56 which lies in a track 54 in the piston 46. A corresponding gasket is arranged in the upper part of the piston 46 but is not shown in detail. These gaskets are arranged to prevent oil/gas flowing out of the pipe.

Moreover, the switch is designed in such a way that it can withstand the pressure which exists during the production of oil and gas in a production system as shown in fig. 1.

With the pig switch which is described in the above and shown in figs. 2 and 3, a pig can be conducted from a pig sender 1 via a common pipe 4 (see fig. 1) to an upper pipe in the pig switch as shown in fig. 2 where the piston 46 is in the lower position, or through a lower, bent pipe 47 as shown in fig. 3 where the piston is in the upper position and on to two alternative pipe branches

in a production pipe system. By arranging several switches one after the other as shown in fig. 1, several production pipes can be pigged, using just one pig sender. This saves a considerable amount of space compared with existing pig systems where one sender is used for each production pipe or a mobile sender is used.

Moreover, control of the switch in accordance with the present invention, ie moving the piston up or down, can be carried out manually or by means of a mechanical, electrical or hydraulic device. Such devices, which can be remotely controlled, are generally known and will not be described in further detail here.

Figs. 5 and 6 show an alternative design of pig switch in accordance with the present invention. Instead of an axially movable piston, a rotatable piston 36^1 is used. The switch housing 31^1 is provided with an inlet pipe socket 50^1 and two outlet pipe sockets 51^1 and 52^1, located above one another. The switch piston 46^1 is also provided with two pipes, one pipe 46^1 which is designed to connect the inlet pipe socket 50^1 with a lower outlet pipe socket 51^1 when the piston is in a position as shown in fig. 5 and another bent pipe 47^1 which is designed to connect the inlet pipe socket 50^1 with an upper pipe socket 52^1 when the piston is rotated to a position as shown in fig. 6. Also with regard to this design, the piston is provided with a spindle 35^1 which can be rotated manually or by means of a drive device.

Moreover, please note that the switch in accordance with the present invention is not limited to the examples which are shown in the figures. Thus the switch can have more than two pipes and be provided with more than three pipe sockets. Furthermore, the pipes can be shaped differently, for example pipe 46^1 can be bent to provide better room for pipe 47^1 and pipe socket 52^1 can be arranged at an angle to the switch housing so that the pipe 47^1 in fig. 6 needs a smaller rotating cylinder.

Claims

1. A pig system for sending and receiving pigs in a pipe system, for example between a production ship or platform and a well head on the sea floor, comprising a pig sender and pig receiver arranged in connection with the pipe system,
c h a r a c t e r i s e d i n t h a t
pig sender (1) is connected with one or more pig switches (19) arranged in series which are provided with two or more switch-over passages (46, 47, 46^1, 47^1) and are designed to steer a pig to a subsequent pig switch or one of several alternative pipes or pipe loops (20).

2. A switch for steering a pig into a pipe system,
c h a r a c t e r i s e d i n t h a t
it comprises a switch housing (31) with an internal change-over switch piston (36) with two or more pipes (46, 47, 46^1, 47^1), that the housing (31) is provided with an inlet (50, 50^1) and two or more outlets (51, 52, 51^1, 52^1), where the piston can be switched over via a spindle so that one of the pipes (46, 47, 46^1, 47^1) corresponds to the inlet (50, 50^1) and one of the outlets (51, 52, 51^1, 52^1), depending on the position of the piston.

3. A switch in accordance with claim 2,
c h a r a c t e r i s e d i n t h a t
the switch piston (36) is provided with two pipes (46, 47) and is axially movable so that switching over from one pipe to another is done by moving the piston from a lower (fig. 2) to an upper (fig. 3) position or vice-versa.

4. A switch in accordance with claim 2, characterised in that the switch piston (36') is provided with two pipes (46', 47') and is rotatable so that the piston is switched over from one pipe to another by rotating it from a first position (fig. 5) to a second position (fig. 6) or vice-versa.

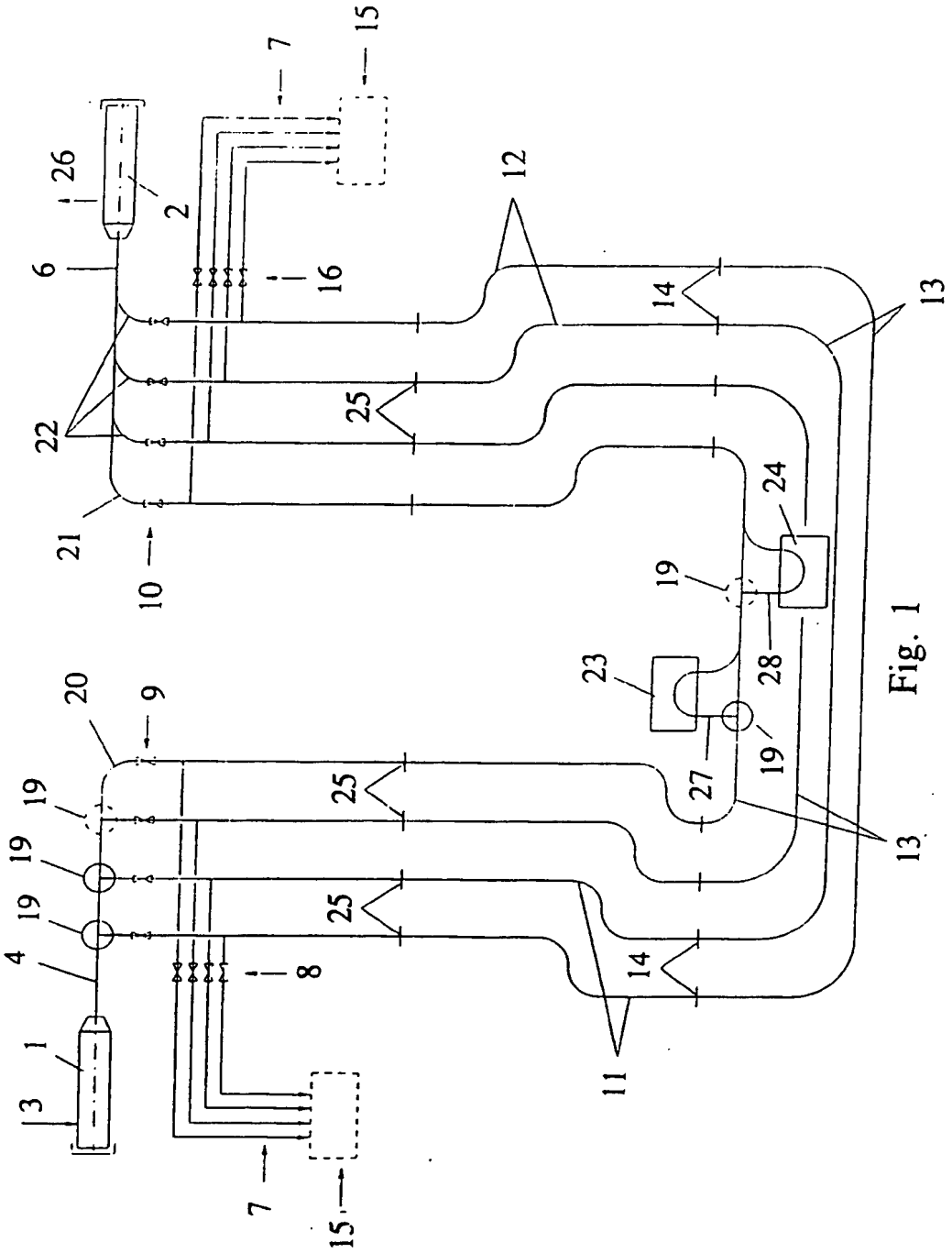

Fig. 1

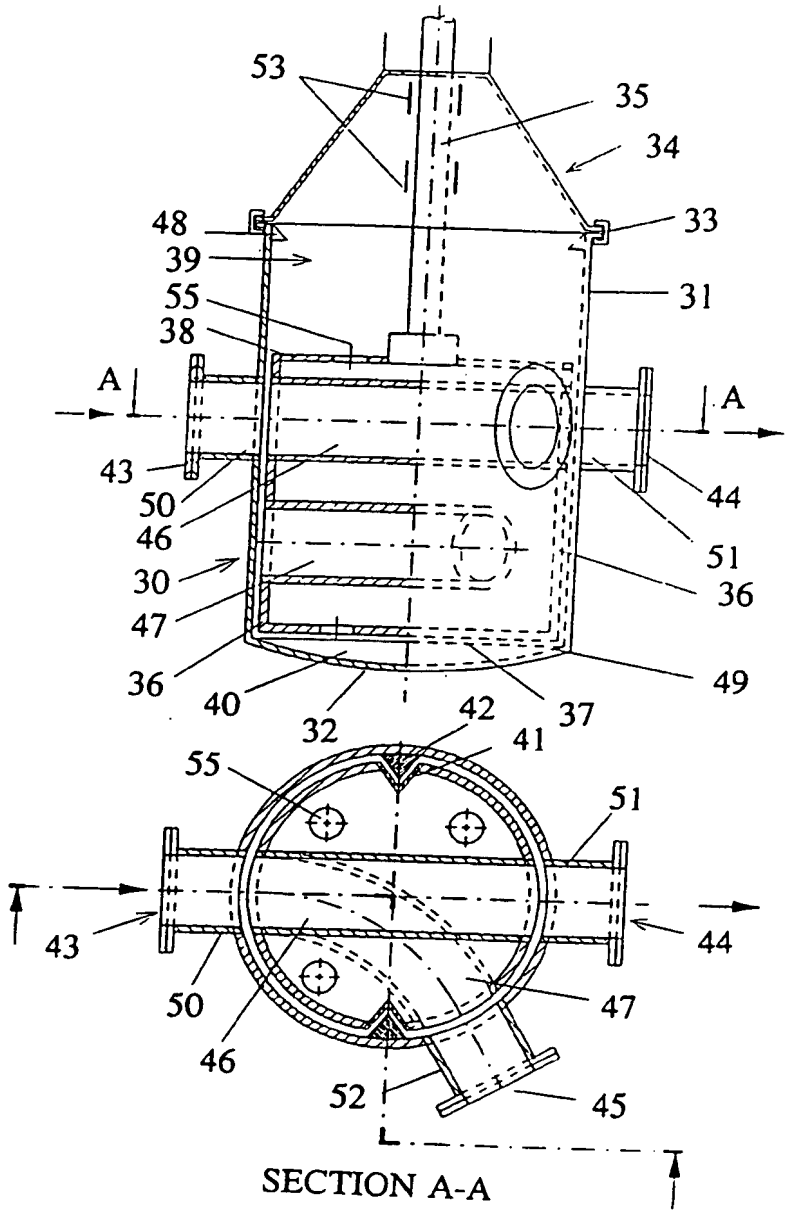

Fig. 2

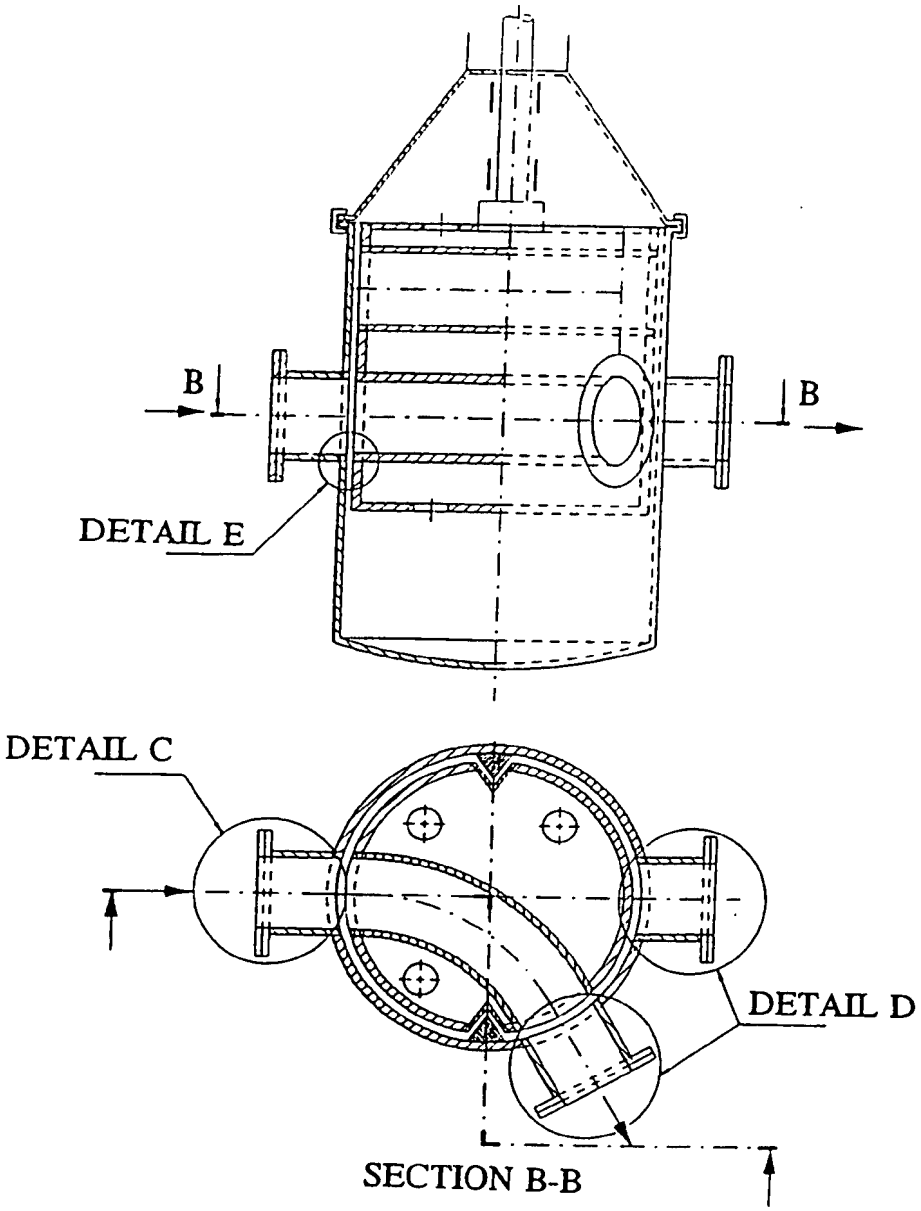

Fig. 3

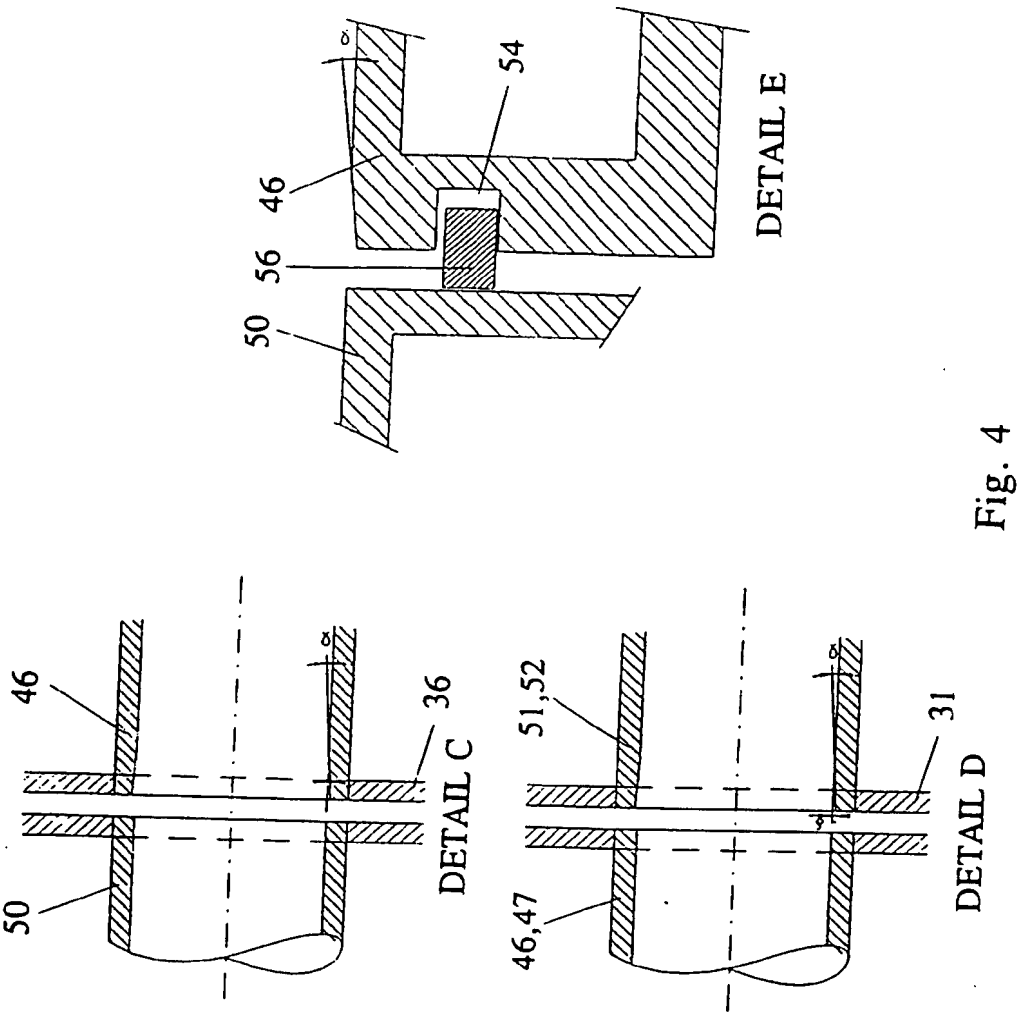

Fig. 4

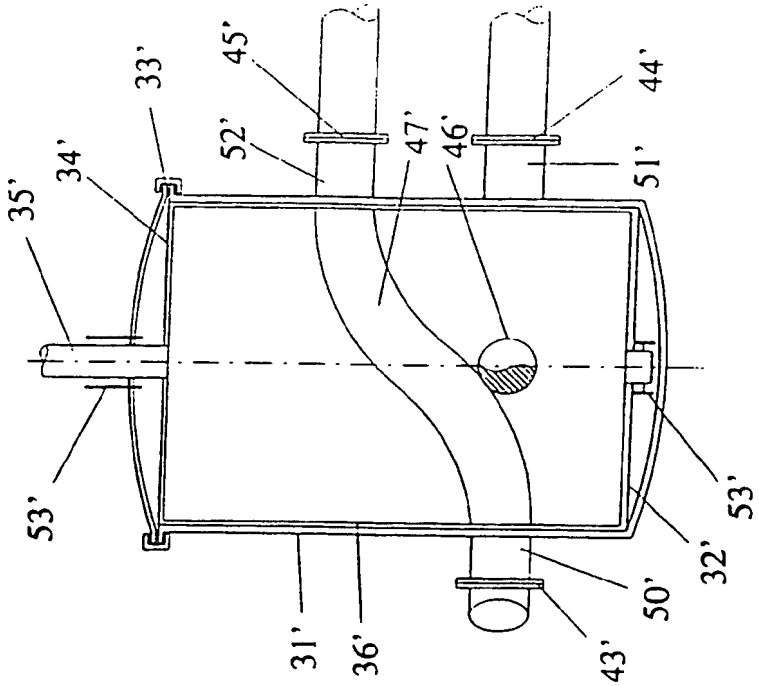

Fig. 6

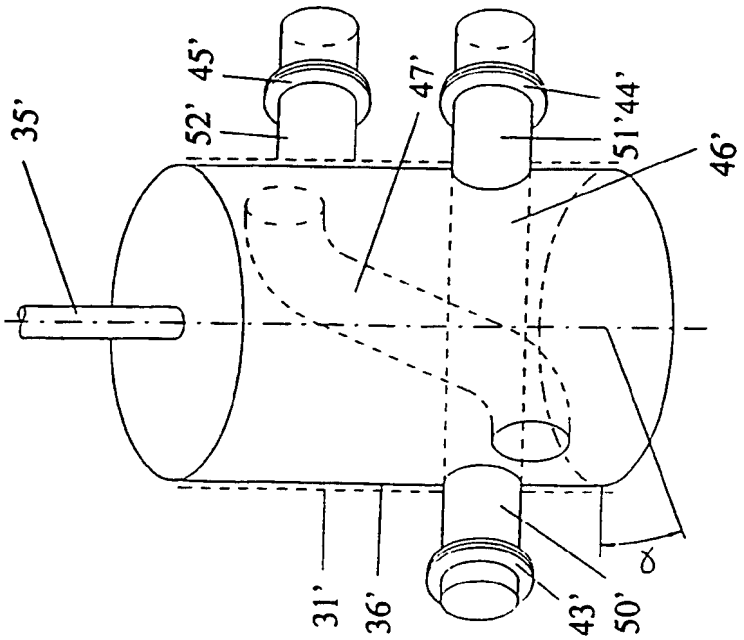

Fig. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO 93/00161

A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 : B08B 9/04
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 : B08B, F17D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP, A1, 0514730 (WEDEMANN, ERNST), 25 November 1992 (25.11.92)	1
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X	US, A, 3473550 (D.A. VAN SCOY ET AL), 21 October 1969 (21.10.69)	2,4
Y		3
	--	
X	US, A, 3674123 (LEWIS ET AL), 4 July 1972 (04.07.72)	2,4
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[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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International application No.
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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US, A, 3246666 (J.H. PARK III, ET AL), 19 April 1966 (19.04.66), column 4, line 64 - column 6, line 51, figures 1-2	3

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INTERNATIONAL SEARCH REPORT

Information on patent family members

28/05/94

International application No.
PCT/NO 93/00161

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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		GB-A- 1308844	07/03/73
		NL-A- 7111409	22/02/72
		NL-A- 7608548	31/12/76
US-A- 3246666	19/04/66	NONE	